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SON 001-86 FOR BA..(U) AIR FORCE ENGINEERING AND
SERVICES CENTER TYNDALL AFB FL M J SANTORO 20 MAY 86

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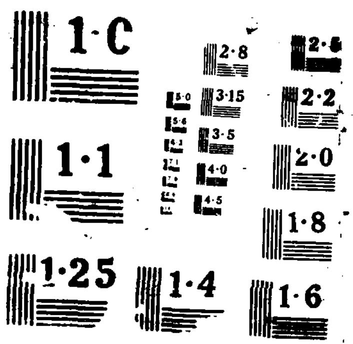
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STATEMENT OF OPERATIONAL NEED

STATEMENT OF OPERATIONAL NEED (SON)
(FORMAT C)
HQ AFESC SON 001-86
FOR BARE BASE/BACKUP POWER SYSTEMS

OPR: HQ AFESC/DEMB 20 MAY 86

AIR FORCE ENGINEERING AND SERVICES CENTER

HEADQUARTERS AIR FORCE
ENGINEERING & SERVICES CENTER

TYNDALL AIR FORCE BASE, FLORIDA

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This SON defines the need for an advanced state-of-the-art generator to supply power for bare base sites and for back-up or emergency power for all base facilities. It specifies the performance criteria desired for the advanced generator.

(Keywords

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HEADQUARTERS AIR FORCE ENGINEERING AND SERVICES CENTER
STATEMENT OF OPERATIONAL NEED (SON) 001-86
FORMAT C
BARE BASE/BACK-UP POWER SYSTEMS

1. MISSION:

a. Mission Area: The primary mission area is Air Warfare Support (USDR&E #225). The secondary mission area is Real Property Maintenance (USDR&E #472).

b. Mission Element Need: The bare base power system is used during expedient construction and operation of air base facilities for contingency force beddown and expedient postattack recovery of vital air base facilities, whereas the back-up system is used primarily during commercial power outages. The specific tasks which must be performed to accomplish both these missions are:

(1) To rapidly establish a sustainable operation at a bare base location vital to the strategic air-to-ground, tactical air-to-ground, tactical air-to-air, strategic airlift, tactical airlift, search and rescue, and command/communications/control (C^3)/intelligence missions.

(2) To provide exigent operation of air base facilities and functions (including surveillance) during commercial electric power disruption or outage caused by natural disaster, accident, sabotage, vandalism, and/or attack in the Continental United States (CONUS) and the overseas theaters.

2. BASIS OF NEED: HARVEST EAGLE developed in 1957-65 and HARVEST BARE developed in 1965-72 remain the mainstay capability of the Air Force to rapidly deploy and operate from bare base locations. Reliable, C-130 air-transportable electricity-generating power systems are critical to both deployment packages. Since the packages were conceived and implemented, there have been dramatic changes in possible deployment scenarios, petroleum fuel availability and cost, fuel and material supply logistics, weapons threats, combat environments, and geographic locations of use. Numerous past experiences in exercises (such as SALTY DEMO), deployments, and ORIs in a variety of contemporary operational environments have indicated clearly the need for improved power systems to support both deployment packages and to support emergency operations when power interruptions occur. This need is based on the fact that bare base and back-up power systems are still employing 1960 vintage technology. Unless a high-priority

research and development (R&D) effort is undertaken to develop new power systems using state-of-the-art technologies, we will be supporting billions of dollars of assets in the 1990s with inadequate, unreliable, and obsolete power systems. Today's systems are marginally adequate but will not be able to meet mission requirements in the very near future. It is imperative that this R&D begin as soon as possible. There have been many suggestions for improving the overall Mobile Electric Power (MEP) family of generators. These efforts have been aimed at making improvements in existing commercially available systems to meet existing needs in acquisition. The Air Force has defined new specifications and performance criteria for acquiring 750-kilowatt (kW) generators based on 1983 technology. This is the only tangible step taken to improve our generating capability, and its viability to meet future mission needs is doubtful.

A major concern is that we continue to procure old technology power systems to replace worn equipment and to fulfill new requirements. This is the only option available since no other power system exists. A second-generation family of power systems would solve this dilemma.

3. EXISTING AND PLANNED CAPABILITIES:

a. Existing electricity-generating capability for Air Force deployment is in the Department of Defense Standard Family of diesel and gas turbine electricity generators as provided by MIL-STD-633, MIL-STD-1332, and Army Supply Bulletin ASB-700-20. Mobile electricity generators from this family have been integrated into the Air Force HARVEST EAGLE and HARVEST BARE packages. Most of these generator systems were conceived for use in a Southeast Asia environment. They are rapidly becoming unresponsive to modern warfare threats and globalization of operation. Their design used what is now obsolete technology making them less reliable and efficient than they should be. All efforts by AFLC (SM-ALC) and AFSC (ASD) in providing generators have been toward satisfying current requirements and have not looked at future requirements.

b. A minor amount of developmental work has been undertaken to correct some power system deficiencies. Research being conducted at the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB OH, is developing small-scale fuel cell technology for military use, but the power outputs being considered (3 to 8 kilowatts) are far too low to satisfy this requirement. Additional work is being conducted by Argonne National Laboratory to develop monolithic fuel cells using a modularized concept. A small amount of work is being conducted in the Army's mobility program, but it focuses on traditional technology within a narrow boundary of theater operating conditions.

c. There are no known other Department of Defense and allied efforts to develop advanced air-transportable electricity systems which meet the performance requirements described in this document. This includes current R&D efforts by DOD MEP. This is due to the fact that all efforts have been directed toward current requirements and not long-range requirements.

d. The required capability will be employed largely in isolation both through airlift as part of established and next-generation deployment packages and through prepositioning. It should interface and interoperate with NATO and other allied force systems, mainly in the role of supplying electricity to meet their temporary needs as well as meeting exigent needs in the CONUS.

4. ASSESSMENT:

a. Evaluation of Existing and Planned Capability:

(1) Current systems are marginally responsive to modern and projected threats, operational environments, support requirements, survivability needs, and economics. For example, current systems are highly vulnerable to collateral damage/neutralization from nearby bomb bursts, cannot be maintained or easily decontaminated in certain combat environments, and are excessive in cost (i.e., up to $1,200/kilowatt). In addition, these systems are well behind the technological power curve and are rapidly approaching obsolescence. As a result, there is severe jeopardy to sustained operation of personnel support services, airfield lighting, field computers, communications, avionics shops, PMEL activities, and all other power-dependent missions of the deployed force.

(2) Current systems have shown a high degree of unreliability, have a high degree of known vulnerability, and are approaching absolescence rapidly. More deficiencies in the current inventory are being made through selective buys of like equipment. Initial operational capability is required in five years, and full operational capability in eight years or less.

(3) There is vast technological opportunity for increased mission effectiveness through development of advanced air-transportable power systems. In addition, the availability of such systems will ensure deployment force readiness and the flexibility to plan and undertake new missions, as warranted by continuing rapid changes in global threats.

(4) There is vast opportunity for cost savings. Current systems have an exceedingly high cost in light of their limited performance capabilities. Use of new materials and modularization concepts, for example, can reduce weight and cube while simultaneously increasing power output and availability and reducing cost significantly.

(5) There is great opportunity to enhance system safety. For example, repairs in current systems are often made through imaginative yet unsafe jerry-rigging such as fuse jumping. Systems using advanced modularization and interoperability concepts will reduce the probability of personnel injury.

(6) Other deficiencies found in current systems are as follows:

(a) Generators are noisy and emit significant infrared and electromagnetic signatures.

(b) Generators have a large amount of protective devices installed on them. These often malfunction, requiring considerable troubleshooting which otherwise would not be necessary.

b. Preferred Known Solution: The below listed constraints are necessary to effectively meet the expressed needs.

(1) There are few constraints that limit acceptable solutions to the need.

(a) The generator developed should have even weight distribution and be transportable by one C-130 aircraft as a complete unit. There should be minimal time for unloading, assembly, placement and start-up, and for cooldown and reloading or relocation.

(b) Equipment must operate in a stand-alone mode in climates typical of all current and projected theaters of operation and when exposed to transient physical shocks, high-temperature thermal radiation, and high-energy pulses such as electromagnetic.

(c) The system must be operable, maintainable, and repairable in all types of foreseeable tactical combat environments (including Chemical, Biological, and Radiological (CBR)) by enlisted personnel with limited training on the equipment. The life cycle of replaceable parts should be extended as much as possible with today's state-of-the-art design.

(d) Ideally, all components should be DOD military standard, interoperable (common parts), and modularized. (Units will be delivered as complete units, but modularization would enhance maintenance efforts.)

(e) The system should have a primary fuel source, diesel or natural gas, with a secondary/back-up fuel source substitutable with no equipment modification and with less than 10 percent degradation of performance from the primary fuel source.

(f) The system should have minimal electromagnetic, infrared, and acoustic signatures.

(g) It should be storable over the long-term (measured in continuous years) with no degradation of design performance, minimal inspection and maintenance, and minimal start-up time.

(h) It should be capable of operating continuously at 35 percent turndown (loading to 65 percent capacity) and at 115 percent of rating over short periods (i.e., four to eight hours), and should be able to operate well beyond the specified time for maintenance.

(i) It should be designed such that a minor system failure does not disable the generator, and such that it will continue to operate for an extended period of time carrying less and less load if a major failure occurs, such as loss of oil pressure.

(j) The system should produce electricity suitable to support HARVEST EAGLE and HARVEST BARE, plus extended aircraft ground maintenance and repair activities.

(k) Multiple voltage connections should be considered as well as minimal unbalanced load constraints.

(l) It should be highly safe and capable of stand-alone continuous operation with the following minimum reliability and maintainability values:

Mean Time Between Maintenance (MTBM)	24 hrs
Mean Time Between Critical Failure (MTBCF)	2,000 hrs
Mean Time Between Overhaul	10,000 hrs
Mission Capable Rate (MC)	95%
Utilization Rate (UR) (Peacetime)	10%
(Wartime)	95%
Uptime Rates (UTR)	95%
Mean Repair Time (MRT)	95% of failures in 1 hr or less
Mean Downtime (MDT)	3 hrs or less
Limits on Frequency of Scheduled Preventive Maintenance Instructions (PMIs)	84,168,335hs for operating 3, 6, 12 months for standby
Critical Operational Reliability	0.995
Corrective Maintenance Reliability	0.5

(m) It shall be designed IAW MIL H-46855B to ensure the design, selection, and testing incorporate human factors into all activities concerning the generator.

(2) Interoperability with similar systems of NATO or other allied forces is required.

(a) It is expected that most interface will be at the electricity producer-user interface (i.e., supplying allies with power) for short periods of time.

(b) Increases in cost due to enhanced performance characteristics responsive to equipment mission should be considered in tradeoff studies (i.e., mean time between failure cost/unit repair and failure/hour operation).

(c) The system should have minimal logistics tail as defined in the Integrated Logistics Support (ILS) Program. The ILS must be planned for and effectively managed through source data derived primarily from the Logistics Support Analysis (MIL-STD-1388-1A and 2A).

(d) The system is intended to eliminate shortfalls and growing deficiencies in current and next-generation deployment capability, and there is hence no viable tradeoff between development and acquisition of the required advanced system, and the continued purchase and resource-intensive operation and maintenance of currently available unsatisfactory systems.

(3) The desired systems will support all HARVEST BARE, HARVEST EAGLE, and theater support to tactical, strategic, and command/communication/control(C^3)/intelligence missions.

(a) Value of the supported assets is placed in the tens of billions of dollars.

(b) The systems also will be available as standby/emergency capability for fixed facilities, and thereby enhance energy security for key mission requirements and activities.

(c) There are limited government or industry resources programmed for development of the required technology.

(4) The basis of the need lies within broad experience including past missions, operational readiness inspections, and large-scale exercises during the past eight years.

(a) These locations include Cairo West and Site Alpha in Southwest Asia, Spangdahlem AB in Europe, and Minot AFB in CONUS. These exercises include CORONET BARE, PROUD FALCON, PROUD PHANTOM, and BRIGHT STAR in which inadequate electricity generator performance severely inhibited readiness, force effectiveness, and mission accomplishment.

(b) In addition, generators from this family have been used in emergency situations in locations such as Shemya AFB AK, Bethel AK, and Cheyenne Mountain CO, with extremely low reliability and unsatisfactory continuous on-line times.

(c) Evaluation of this cumulative performance history against current and projected deployment and other mission scenarios clearly points out the imprudence of relying on current systems.

(d) Current generators are only designed and procured for 72-hour maximum back-up power; some theater-unique generators are unreliable.

c. Impact of Staying with Present Capability:

(1) If the needed capability is not developed, there will be severe adverse impact on combat effectiveness and threat-meeting capability. Bare base facilities in theaters of operations and rearward will operate inadequately in supporting tactical and strategic missions, risking high personnel and equipment/material losses. In addition, there will remain no reliable exigent power back-up for critical facilities such as C^3, surveillance, and combat support during times of conventional power outage or disruption, thereby increasing national vulnerability to attack.

(2) Increased quantities of existing equipment cannot satisfy this need.

(3) This need is mission-critical and should be addressed on a highest priority basis in order to meet the required urgent timing for full operational capability.

5. PRELIMINARY OPERATIONAL AND SUPPORT CONCEPTS:

a. Concept of Employment: Power systems may be deployed to a bare base or may be prepositioned at main operating bases, collocated operating bases, or forward operating locations in whatever numbers are required to support population and mission requirements. Power systems may be used globally, in all seasonal environments, and in any of the climatic extremes listed in MIL-STD-210B.

b. Support Concept: The power system shall be maintained within the existing two levels of maintenance:

(1) Operator-Level Maintenance: Operator-level maintenance is considered those day-by-day, routine servicing inspection, minor adjustment, or repair actions normally performed by an operator during the course of duty tour. This maintenance shall be performed by five-skill-level maintenance technicians.

(2) Depot-Level Maintenance: Depot- level maintenance is considered those servicing, adjustment, repair, overhaul or more detailed inspection items performed by maintenance personnel which are beyond the capabilities of a shift operator. This may be performed by established depot-level maintenance teams or by contractor-operated facilities.

c. Training: Intermediate- and depot-level maintenance training will be required for this new equipment and will be provided either by the manufacturer or through Air Training Command training courses. Maintenance training will be accomplished using operational equipment.

d. Spare Parts: Provisions shall be made for spare parts that can be interchanged quickly and easily and can be readily available at the appropriate maintenance level.

e. Support Equipment: The generator shall not require any special support equipment and shall be able to utilize common hand tools and other existing support equipment already in the Air Force inventory. Support equipment shall be capable of isolating 90% of all failures to a replaceable component or unit.

6. PROPOSED PROGRAM:

a. System Description: The power system (or family of systems) will be rugged, portable, reliable, affordable, and simple to maintain.

b. Expected System Performance: The characteristics and performance goals of the power system are as follows:

(1) Up to 750-kilowatt capacity. To maintain as much similarity in design as possible, the 750-kilowatt capacity can be subdivided into a minimum of five separate nominal power classes: less than 10 kW, 10-60 kW, 75-125 kW, 150-300 kW, and 400-750 kW.

(2) Should be capable of producing power in single-phase and three-phase low voltage ranges of 120/208, 120/240, and 240/416 volts, and high voltage of 2400/4160 volts for the 750-kilowatt units. To ensure NATO interoperability, 220/380 and 240/416 volts at 50 hertz (Hz) should be available.

(3) Must produce alternating current at 50/60 Hz at the output stage.

(4) Should use multiple fuels (JP-4, JP-5, diesel, jet A, etc.).

(5) Should use cleanable air and fuel filters.

(6) Should be quiet.

(7) Must have good cold weather starting characteristics.

(8) Should have low infrared signature.

(9) Should have effective ignition shield for electromagnetic protection.

(10) Must be operable worldwide.

(11) Must be able to withstand transportation and handling abuse.

(12) Should be lightweight and compact, easily transported (including by Civil Reserve Air Fleet (CRAF), and set up by no more than one person in less than four hours (worst case, largest generator, delivered to site).

(13) Should be camouflaged and chemically resistive coated (CARC). CARC allows proper decontamination in a chemical warfare environment and provides added corrosion control for equipment.

(14) Should be easy to harden against sabotage or terrorism.

c. Acquisition Strategy:

(1) Development: Various manufacturers should be invited to design and prototype at least two advanced power systems in each kW range selected.

(2) The need for new power systems is so urgent that procurement and production decisions should be addressed in several phases during the R&D effort. Specific milestones should be established to ensure production decisions of this nature are made in a timely manner, and testing is adequately accomplished before such production is pursued.

(3) Using technical improvements and innovations from the design phase and following MIL-SPEC requirements, operational power systems could be constructed.

(4) Appropriate diagrams and technical data pertaining to manufacture and maintenance of all components should be purchased.

(5) Engineering data will be acquired in accordance with AFR 800-34, AFSC/AFLC Supplement 1, and Air Force Engineering Data Requirements Document (EDRD) to allow for competitive reacquisition and other logistic functions.

(6) AFR 800-12, dated 13 Dec 85, will apply to the acquisition of support equipment and to support equipment for support equipment.

d. Safety:

(1) An effective system safety engineering program IAW MIL-STD-882B and AFR 800-16 should be fully integrated into all aspects of the engineering design effort. This program should include the following as a minimum:

(a) Preliminary Hazard Analysis (PHA)

(b) Operating and Support Hazard Analysis (OSHA)

(2) MIL-STD-454, Requirement 1, Personnel Safety, will be applied.

(3) MIL-STD-1472C Notice 2, Human Engineering, will be applied.

e. Technical Data: All operation, maintenance, test and inspection procedures, and TOs or manuals will be developed IAW MIL-M-38784A to assure compliance with AFOSH/OSHA standards. Technical data shall be validated before the start of operational test and evaluation (OT&E), and shall be fully verified before the central operational capability (COC) required date.

f. Preliminary Test Strategy: Prototype power systems should be tested by:

(1) Component subsystem and system testing for required performance and survivability including simulated weapons effects.

(2) Carefully monitored use in selected exercises for performance evaluation.

(3) Competitive operational testing of alternative manufacturer's prototypes (i.e., a "power-off").

(4) MIL-STD-705 testing.

g. **Schedule**: See Attachment 1.

h. **Program Decision Package**: See Attachment 2.

i. **Requirements Correlation Matrix**: See Attachment 3.

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s. AFR 400-50, 1 Oct 80, "Joint Operating Procedures Management and Standardization of Mobile Electric Power Generating Sources."

t. AFSC Design Handbook DH-1-11, "Air Transportability."

u. AFSC Design Handbook DH2-6, "Ground Equipment and Facilities.

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ORIGINATING COMMAND: AIR FORCE ENGINEERING AND SERVICES CENTER

20 MAY 1986

[illegible], USAF
Commander
Air Force Engineering and
Services Center

IMPLEMENTING COMMAND: AIR FORCE SYSTEMS COMMAND

23 OCT 1987

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SUPPORTING COMMAND: AIR FORCE LOGISTICS COMMAND

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HQ ATC/TTY	6
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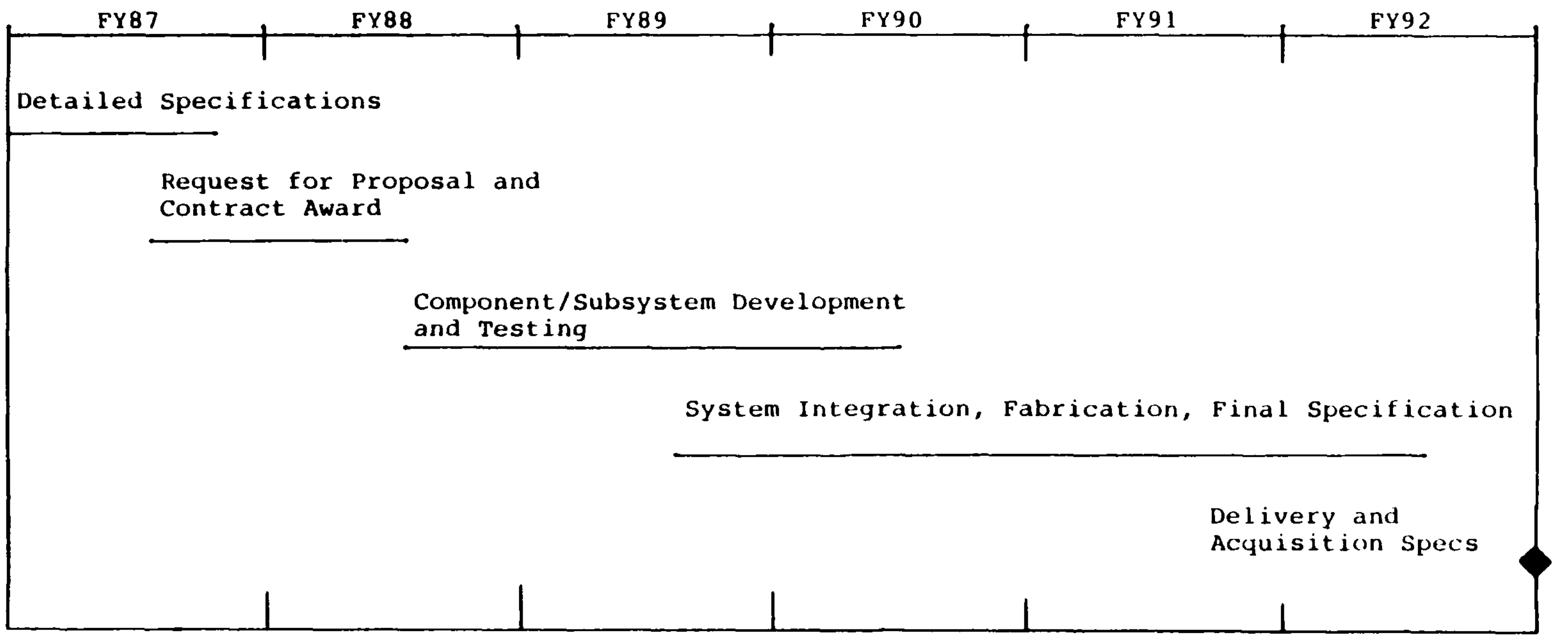
WR-ALC/XRX	2
ASD/XR	2
BMO/SYS	1
HQ AFCC/SIP	6
HQ AFIS/XP	4
AFRES/XP	2
NGB/XO	3
HQ AAC/PR	3
HQ AFSPACECOMD/XPX	3
HQ MAC/XPQ	3
HQ PACAF/DOQ	3
HQ SAC/XPP	3
HQ TAC/DR	3
HQ USAFE/DOQ	10

TENTATIVE PROGRAM SCHEDULE FOR BARE BASE/BACKUP POWER SYSTEM



BARE BASE/BACK-UP POWER SYSTEM

Develops, tests, and evaluates reliable, survivable, and sustainable power generation capability essential to supporting bare base operations and fixed air base back-up power requirements. Reference HQ AFESC SON 001-86, 20 May 86, and the following mission areas: USDR&E #225 Air Warfare Support (primary) and USDR&E #472 Real Property Maintenance (secondary). System will generate up to 750 kilowatts of power, will be survivable against known theater conventional warfare threats, and will be capable of unattended sustained operation to meet Air Force and allied force power requirements in combat operations.

Resource Impact ($M)	FY87	FY88	FY89	FY90	FY91	FY92
System Development:						
Program Element 63723F (6.3)	0.3	2.0	1.5	0.5	0.5	0
Program Element 64708F (6.4)	0	0	2.0	2.5	2.5	3.0
Total Obligation Authority	0.3	2.0	3.5	3.0	3.0	3.0

Atch 2

BARE BASE/BACK-UP POWER SYSTEMS
REQUIREMENTS CORRELATION MATRIX - PART I

PARAMETER	REQUIREMENTS SON MAY 86	SORD 1	SORD 2	SPECIFICATIONS MAY 86			TEST CRITERIA MAY 86		
1. Transportable by one C-130 aircraft	Yes (r)			TBD			TBD		
2. Minimal time for set up and relocation	Yes (g)								
3. Operate in stand-alone mode in theater sites	Yes (r)								
4. Operable, maintainable, reliable in all types of tactical environments	Yes (r)								
5. DOD standardized components, interoperable, and modularized	Yes (r)								
6. Primary fuel source diesel or natural gas w/secondary back-up source	Yes (r)								
7. Minimal electromagnetic and infrared signature	Yes (g)								
8. Storable over long periods with no degradation of performance	Yes (g)								

PARAMETER	REQUIREMENTS SON MAY 86	SORD 1	SORD 2	SPECIFICATIONS MAY 86			TEST CRITERIA MAY 86		
9. Operate continually at 35% turndown and at 115% of rating for 4 to 8 hours	Yes (r)			TBD			TBD		
10. Minor system failures don't disable system	Yes (g)								
11. Suitable for HARVEST EAGLE/ HARVEST BARE	Yes (r)								
12. Multiple voltage connections	Yes (g)								
13. Interoperable with similar NATO or other allied forces systems	Yes (r)								
14. Minimal logistics tail	Yes (g)								
15. Mean time between maintenance (MTBM)	24 hrs (g)								
16. Mean time between critical failure (MTBCF)	2,000 hrs (g)								
17. Mean time between overhaul	10,000 hrs (g)								
18. Mission capable rate (MC)	95% (g)								

PARAMETER	REQUIREMENTS MAY 86	SORD 1	SORD 2	SPECIFICATIONS MAY 86			TEST CRITERIA MAY 86	
19. Utilization Rate (UR)				TBD			TBD	
Peacetime	10% (g)							
Wartime	95% (g)							
20. Uptime rate (UTR)	95% (g)							
21. Mean repair time (MRT)	95% of failures in ≤ 1 hr (g)							
22. Mean downtime (MDT)	≤ 3 hrs (g)							
23. Limits on frequency of scheduled preventive maintenance instructions (PMIs)	84,168,335 hrs (operating) (g) 3, 6, or 12 months (standby) (g)							
24. Critical operational reliability	0.995 (g)							
25. Corrective maintenance reliability	0.5 (g)							

(g) = goal
(r) = requirement

BARE BASE/BACK-UP POWER SYSTEMS
REQUIREMENTS CORRELATION MATRIX - PART II
RATIONALE FOR CHANGES

SORD I UPDATE

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